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(54) **Apparatus and method for communication control**

(57) Apparatus, and an associated method, facilitates service degradation in a radio communication system, such as a cellular communication system. A service degradation profile is created and includes values of QoS (quality of service) level values. If communication at levels corresponding to the values of the desired QoS level parameters is unavailable, efforts are made to effectuate, or maintain communication at quality levels corresponding to values of at least first QoS level parameters values. Service degradation thereby occurs pursuant to a selected profile, reducing the need for service renegotiations and reducing the possibility that an abrupt termination of a communication session might occur.

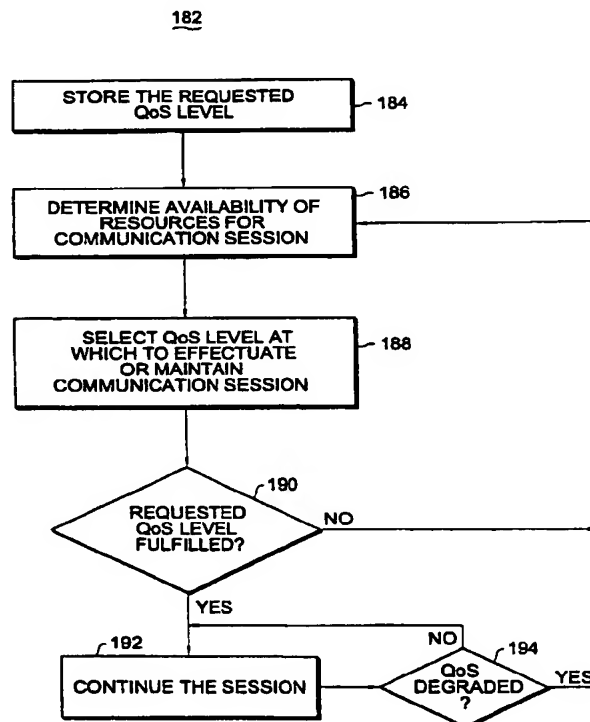


FIG. 7

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## Description

**[0001]** The present invention relates generally to communication quality levels in a radio communication system, such as a cellular communication system. More particularly, the present invention relates to apparatus, and an associated method, for facilitating controlled degradation of a QoS (quality of service) level parameters during a communication session in the radio communication system if a desired QoS level parameter is unable to be maintained.

**[0002]** A communication system permits the communication of information between a sending station and a receiving station and is formed, at a minimum, of a transmitter, located at the sending station, and a receiver, located at the receiving station, interconnected by a communication channel. Communication signals are formed of the information to be transmitted by the sending station. Communication signals are formed to be of characteristics to permit their transmission upon the communication channel. The receiving station is tuned to receive the communication signals transmitted upon the communication channel. Information contained in the communication signal transmitted upon the communication channel is recovered, once received at the receiving station.

**[0003]** A radio communication system is a communication system in which the communication channel upon which the communication signal is transmitted is formed of a radio channel defined upon a portion of the electromagnetic spectrum. Because a wire line connection is not required to form the communication channel between a sending and a receiving station, communications are possible when such a wire line connection between the sending and receiving station would be impractical.

**[0004]** A cellular communication system is exemplary of a radio communication system. Cellular communication systems, constructed according to various standards, have been installed throughout significant portions of the world. A subscriber to a cellular communication system is able to communicate therein by way of a mobile station when the mobile station is positioned within an area encompassed by the communication system. Telephonic communication of both voice information and data information is permitted in such networks.

**[0005]** Access to communication by way of the cellular communication system is permitted pursuant to a service subscription to which a subscriber subscribes. A unique identification number is associated with the service subscription. The identification number is used in authentication procedures to provide a mobile station, operable pursuant to the service subscription, access to the cellular network. The identification number is also used for billing purposes.

**[0006]** QoS (quality of service) level parameters can be defined to provide a standard by which to measure or

ensure minimum communication quality levels. A QoS level parameter can be used in service initiation and service modification. A QoS level parameter defines a communication quality level in terms of, e.g., a data transmission rate, a bit error rate, or a signal delay amount upon a forward link and upon a reverse link. To ensure that appropriate communication quality levels are achieved during service initiation, the QoS level parameter must be met to ensure an appropriate level of communication quality, defined by the values of the parameters associated with the QoS level. However, the QoS level parameters might not be able to be achieved during a particular communication session. Such parameters may not be able to be achieved during service initiation during which the communication session is attempted to be initiated, or during the communication session, such as when a hand off is requested or otherwise attempted. The desired QoS level parameters may not be able to be attained or maintained due to lack of resources available for the communications during the communication session. If the desired QoS level parameters cannot be attained or maintained, there might be a service renegotiation between the network infrastructure and the mobile station which requires significant levels of control signaling between the mobile station and the network infrastructure and also within the network. Such control signaling is referred to as overhead as the signaling requires system resources without directly providing user communications. The existing requirement to provide service renegotiation when a desired QoS level parameter cannot be attained or maintained is therefore a disadvantageous use of the system resources. Alternately, if there is not a service renegotiation, there is a possibility that a noticeable and abrupt service degradation during a communication session might occur.

**[0007]** A manner by which to provide for a managed and non-abrupt service degradation of QoS level parameters during a communication session without requiring significant service renegotiation would therefore be advantageous.

**[0008]** It is in light of this background information related to quality of service level parameters of communications in a radio communication system that the significant improvements of the present invention have evolved.

**[0009]** In accordance with first aspect of the present invention there is provided a radio communication system having a fixed network including a plurality of spaced-apart, fixed-site transceivers positioned throughout a geographic area, each fixed-site transceiver defining a coverage area in which communications with a mobile station are permitted pursuant to a service subscription, a combination with the fixed network of apparatus for reducing a desired QoS (quality of service) level of communications between the mobile station and the fixed network to a selected degraded QoS level when continued communications pursuant to

at least a first communication service at the desired QoS level is unavailable, said apparatus comprising:

a service subscription register associated with the mobile station, said service subscription register for storing an indication of at least a first selected degraded QoS level at which the communications pursuant to the at least the first communication service are to be maintained if the continued communications at the desired QoS level are unable to be maintained; and

a resource availability determiner and service level selector coupled to receive information representative of the at least the first selected degraded QoS level when the communications are unavailable at the desired QoS level, said resource reserver for selectively reserving resources of the radio communication system to assure that the communications are able to continue pursuant to the at least the first degraded QoS level.

**[0010]** In accordance with a second aspect of the present invention there is provided a method for reducing a desired QoS (quality of service) level of communications between a mobile station and a fixed network of a radio communication system to a selected degraded QoS level when communication pursuant to at least a first communication service at the desired QoS level is unavailable, said method comprising the steps of:

storing an indication of at least a first selected degraded QoS level at which the communications pursuant to the at least the first communication service are to be maintained if the communications at the desired QoS level are unable to be maintained;

determining availability of resources for the communication pursuant to the first communication service at the desired QoS level; and

selecting the communication at the first selected degraded QoS level if a determination is made during said step of determining that the communication at the desired QoS level is unavailable.

**[0011]** In accordance with a third aspect of the present invention there is provided a cellular communication system having a network infrastructure installed in a geographic region and mobile stations capable of communication with the network infrastructure pursuant to at least a first communication, when located in the geographic region, a combination with the network infrastructure of a storage device for storing SDP (service degradation performance) data, said storage device comprising:

a mobile station identifier portion for storing mobile station identification indicia which uniquely identifies various ones of the mobile stations;

a SDP data storage portion having locations indexed together with the mobile station identification indicia stored at said mobile station identifier portion, each location of said SDP data storage portion for storing an indication of at least a first degraded QoS level at which communications are to be maintained between the network infrastructure and the mobile station to which the location of said SDP data storage portion is indexed together if the communications are unable at a desired QoS level.

**[0012]** The present invention, accordingly, advantageously provides apparatus, and an associated method, for facilitating controlled degradation of QoS level parameters of communications in a radio communication system, if communications at desired QoS level parameters are unable to be effectuated or maintained.

**[0013]** In one aspect of the present invention, a service degradation profile is stored in a storage register. The service degradation profile is associated with a mobile station operable in a radio communication system. The service degradation profile includes one or more degraded QoS level parameters at which to attempt to effectuate or maintain communications in the event that desired QoS level parameters cannot be achieved. If the desired QoS level parameters cannot be achieved, an attempt is made to communicate at QoS level parameters corresponding to the degraded QoS level parameters stored as part of the service degradation profile. Thereby, in the event that the communication cannot be effectuated or maintained at a desired QoS level parameter, the communication shall be effectuated or continue at the degraded QoS level parameter without the need for control signaling with the mobile station and within the infrastructure to renegotiate service quality levels. Also, because the service degradation occurs pursuant to the prescribed service degradation profile, abrupt service degradation does not occur. Rather, the service degradation occurs pursuant to the parameters of the service degradation profile.

**[0014]** A storage register stores a service degradation profile. The service degradation profile includes an indication of one or more degraded QoS level parameters to be maintained in the event that a desired QoS level parameter is unable to be attained or maintained during a communication session. If the desired QoS level parameter of ongoing communication session is unable to be maintained, an attempt is made to effectuate or continue communication at a reduced-quality degraded QoS level parameter corresponding to a degraded QoS level parameter stored as part of the service degradation profile.

**[0015]** When implemented in a cellular communication system, the service degradation profile forms part of a service subscription plan and is stored at the HLR (home location register) associated with the mobile station. If, during initiation of communications or during

ongoing communications, such as when a hand off between base stations is attempted, communications at the desired QoS level parameter cannot be achieved, a degraded QoS level parameter stored as part of the service degradation profile is accessed. Communications with the mobile station at the degraded QoS level parameter is attempted. Service renegotiation with the mobile station is not required as the service degradation profile is automatically accessed and communications are effectuated, if possible, at the degraded QoS level parameter. Thereby, system overhead, such as control signaling between the network and the mobile station, is reduced. When communication conditions require that the QoS level parameter of communications with the mobile station be reduced, the service degradation is implemented in a controlled and non-abrupt manner.

[0016] In one implementation, the service degradation profile is implemented in a cellular communication system, such as a cellular communication system conforming to the standards set forth in the IS-95 3G specification promulgated by the EIA/TIA. The service degradation profile is stored together with other subscriber profiles at the HLR (home location register) associated with the mobile station. If communication cannot be effectuated or maintained at desired QoS level parameters, the service degradation profile is accessed, and communications are effectuated or maintained, if possible, at the degraded QoS level parameters stored as part of the service degradation profile. Service renegotiation with the mobile station is not required as the service degradation profile is automatically accessed. And, because the service degradation is implemented pursuant to a prescribed service degradation profile, abrupt service degradation of communications with the mobile station are less likely to occur.

[0017] In these and other aspects, therefore, apparatus, and an associated method, is provided for reducing a desired QoS (quality of service) level parameter of communications between a mobile station and a fixed network of a radio communication system. The fixed network includes a plurality of spaced-apart, fixed-site transceivers positioned throughout a geographic area. Each fixed-site transceiver defines a coverage area in which communications with a mobile station are permitted pursuant to a service subscription. The desired QoS level parameter is reduced to a selected degraded QoS level parameter when communications pursuant to at least a first communication service at the desired QoS level is unavailable. A service subscription register is associated with the mobile station. The service subscription register stores an indication of at least a first selected degraded QoS level parameter at which the communication pursuant to the at least the first communication service are to be maintained if the continued communications at the desired QoS level parameter are unavailable. A resource availability determiner is coupled to receive information representative of at least the

first selected degraded QoS level parameter when the communications at the desired QoS level parameter are unavailable. The resource availability determiner and service level selector selectively determines the availability of resources of the radio communication system and selects service levels to assure that the communications are available at least at the first degraded QoS level parameter.

[0018] A more complete appreciation of the present invention and the scope thereof can be obtained from the accompanying drawings which are briefly summarized below, the following detailed description of the presently-preferred embodiments of the invention, and the appended claims.

Figure 1 illustrates a portion of a cellular communication system which includes an embodiment of the present invention as a portion thereof.

Figure 2 illustrates a table listing an exemplary service degradation profile pursuant to which QoS level parameters are maintained during operation of the communication system shown in Figure 1.

Figure 3 illustrates a table, similar to that shown in Figure 2, but here listing another exemplary service degradation profile pursuant to which QoS level parameters are maintained during operation of the cellular communication system shown in Figure 1.

Figure 4 illustrates another table, similar to those shown in Figures 2-3, but here illustrating another service degradation profile pursuant to which the QoS level parameters are maintained in a communication session during operation of the cellular communication system shown in Figure 1.

Figure 5 illustrates another table, similar to those shown in Figures 2-4, but here showing another service degradation profile of QoS level parameters pursuant to which communication levels are maintained during a communication session of the cellular communication system shown in Figure 1.

Figure 6 illustrates another table similar to that shown in Figures 2-5, but here showing the service degradation profile which also has a priority level associated therewith, used during resource contention to determine allocation of resources between competing mobile stations.

Figure 7 illustrates a method flow diagram listing the method steps of the method of operation of an embodiment of the present invention.

[0019] Referring first to Figure 1, a portion of a cellular communication system, shown generally at 10, is installed throughout a geographical area. The cellular

communication system 10 permits telephonic communications between network infrastructure of the communication system and mobile stations, of which the mobile station 12 is exemplary. In the exemplary embodiment illustrated in the Figure, the cellular communication system is constructed to comply with the standards set forth in the IS-95 3G specification promulgated by the EIA/TIA. Cellular communication systems, and other radio communication systems, can similarly be represented, and an embodiment of the present invention is analogously operable in such other communication systems.

**[0020]** A plurality of cells 14 are defined in the system 10. A radio base station 16 is associated with each of the cells 14. The radio base stations 16 are formed of fixed-site transceivers capable of two-way communications with a mobile station, such as the mobile station 12. A Communication signal transmitted by a base stations 16 to a mobile station is transmitted upon a channel referred to as a forward link, and a communication signal generated by the mobile station and transmitted to a radio base stations 16 is transmitted upon a communication channel referred to as a reverse link. The base stations 16 are positioned at spaced-apart locations throughout the geographical area encompassed by the communication system 10 in manners such that the two-way coverage areas by which the cells 14 are defined at least partially overlap with one another. For purposes of illustration, the base stations 16 are positioned at the centers of their associated cells 14. In actual implementations, other arrangements are possible. For instance, base stations utilizing sector antennas are sometimes utilized so that more than one base station may be colocated and cells associated with the base station are defined by the sectors of coverage of such sector antennas.

**[0021]** The base stations 16 are here shown further to be coupled to base station controllers, of which the base station controller (BSC) 22 is exemplary. Typically, several base stations are coupled to, and are controlled by, a single BSC. Each BSC is coupled to a mobile switching center (MSC), of which the MSC 24 is exemplary. A number of BSCs are typically coupled to a single MSC. An MSC, such as the MSC 24, is coupled to a public-switched telephonic network (not shown).

**[0022]** The mobile switching center 24 is here shown to include an HLR (home location register) 28. A portion of the HLR 28 forms a service subscription register 32.

**[0023]** Cellular communication systems make efficient use of the portion of the electromagnetic spectrum allocated for communications therein. Because of the spaced-apart nature of the base stations, the communication signals transmitted between the mobile station and a base station 16 located proximate thereto need only be of a relatively low power level. Because of transmission of the communications signals at such relatively low power levels, the same channels may be re-used at various cells of the system according to a channel allo-

cation scheme. Thereby, a relatively large number of concurrent communications can be effectuated within a limited bandwidth allocation.

**[0024]** Advancements in communication techniques, particularly digital techniques, have permitted new types of radio communication services to be implemented and popularized. For instance, communication services including video conferencing, Internet web-browsing and video-on-demand services can all be provided. For example, such services are possible in a cellular communication system 10 constructed pursuant to the standards set forth in the IS-95 3G specification.

**[0025]** QoS level parameters set forth parameters associated with communication quality levels required for service initiation or modification of a communication session between a mobile station and the cellular network infrastructure. The QoS level parameters include, for example, data transmission rates, bit error rates of transmitted data, and signal delays for the forward and reverse links. While the QoS level parameters are of values intended to ensure an appropriate level of communication quality of communication signals transmitted between the mobile station and the network infrastructure, there is some possibility that not all of the QoS level parameters can be achieved for a particular communication session. Or, during a communication session, there is some possibility that the QoS level parameters cannot be maintained. For instance, when a mobile station travels between cells of the communication system, the QoS level parameters in a cell to which a hand over is to be effectuated may not be able to be attained. That is to say, the resources required to achieve such QoS level parameters might not be available for the communication session. In conventional implementations, termination of the communication session would result. And, proposals by which to renegotiate service with the mobile station, either over a radio interface with the mobile station or otherwise utilizing network resources, is costly in terms of increased overhead. Operation of an embodiment of the present invention provides a manner by which to avoid abrupt communication termination and to avoid the need for elaborate service renegotiation in the event that communication at desired QoS level parameters cannot be achieved.

**[0026]** The mobile station 12 is associated with an HLR, here the HLR 28. The HLR stores data, *inter alia*, forming a service degradation profile (SDP). During operation of an embodiment of the present invention, the data stored at the HLR forming the service degradation profile is selectively utilized to provide for controlled degradation of communication service performance when communication resources available for a communication session cannot assure that desired QoS level parameters can be achieved. The base station controller 22 is here shown further to include a resource availability determiner and service level selector 34. The determiner and selector 34 forms a functional entity.

Such portion of the base station controller, or a group of base station controllers, is operable to determine QoS level parameters of selected communication links of the communication system 10 and checks the resource availability of both the MSCs and BSCs when making such determinations. Lines 34' and 34'' shown in dash, are representative of such checks. Responsive to the determinations, selective access is made to the service degradation profile 32 stored at the home location register 28.

**[0027]** Figure 2 illustrates a service degradation profile 32 of an embodiment of the present invention. The service degradation profile forms part of the subscription information associated with a service subscription for subscriber service to communicate in the cellular communication system 10 shown in Figure 1. Here, the data forming the service degradation profile is indexed against an identifier which uniquely identifies the subscription accounts, here the IMEI (international mobile station equipment identity) 38. In the exemplary illustration, the service subscription provides at least for audio communications. In the Figure, the column 42 indicates the subscription-type associated with the IMEI and, here, the subscription-type is indicated to be an audio subscription 44.

**[0028]** A primary selection 46 of QoS level parameters is associated with the audio subscription. Here, the parameters include a bit rate selection 48, a delay time selection 52, and a BER (bit error rate) selection 54. Values of these parameters are indicated by values 56, 58, and 62, respectively, for forward link communications and by the values 64, 66, and 68 for reverse link communications. Viz., the upper row, containing the values 56, 58, and 62 define parameters for the forward traffic channel, and the values 64, 66, and 68 define parameters for the reverse traffic channel. Communications on the forward and reverse links are to meet or exceed such values for a selected quality level of communications.

**[0029]** The profile 42 further includes a set of first degradation QoS level parameters 72. Analogous to the set of parameters 46, the set of parameters 72 includes a bit rate selection 74, a delay time selection 76, and a BER selection 78. First degradation level values of such parameters for forward link communications, i.e., on the forward traffic channel, are indicated at 82, 84, and 86, respectively. And, first degradation parameter values for reverse link communications, i.e., on the reverse traffic channel, are indicated at 88, 92, and 94. The values of the first degradation QoS parameters set forth values which must be met or exceed to ensure quality of communications as least as good as a first degradation level. If communication quality levels corresponding to the primary QoS level parameters 46 cannot be ensured, communication is attempted to be effectuated, or maintained, at the first degradation level, indicated by the values of the parameters 72.

**[0030]** The profile 32 also includes a set of second

degradation QoS level parameters 96. The set again includes a bit rate selection 98, a delay time selection 102, and a BER selection 104. Again, the values, here values 106, 108, and 112, respectively, are associated with the selections of the set of second degradation QoS level parameters for communications on the forward traffic channel. And, values 114, 116, and 118 identify corresponding values of the reverse link, i.e., on the reverse traffic channel. When communications cannot be effectuated or maintained at the quality of service level of the first degradation parameters, communications are attempted to be effectuated or maintained at the quality of service levels identified by the parameters of the set 96.

**[0031]** Because the service degradation profile 32 is stored at the home location register 28, the values contained in the profile are accessed automatically when the resource availability determiner and service level selector 34 (shown in Figure 1) indicates that communication quality of service levels cannot be effectuated or maintained. Service renegotiation does not require significant system overhead, and communication sessions are better able to be effectuated and maintained.

**[0032]** Figure 3 illustrates another exemplary service degradation profile 32. Here, the profile pertains to a service subscription permitting video conferencing. Again, the values of the profile 32 are indexed together with an IMEI value 38. And, the column 42 indicates the subscriptiontype which, for video conferencing, includes audio 44, video 152, and data 154. Again, a set of primary QoS level parameters 46, a set of first degradation QoS level parameters 72, and a set 96 of second degradation QoS level parameters form the service degradation profile. Additional steps of degradation QoS level parameters can further be provided. Bit rate, delay time, and BER selections 48-54, 74-78, and 98-104, form components of the respective set 46, 72, and 96 in analogous manner to that described with respect to the profile 32 of Figure 2. The values of the selections of the various sets are referenced with the same reference designations as those used previously, but here also with the suffixes -A, -V, -D to indicate values of audio, video, and data for the various selections. And, for each of the sets, top rows pertain to forward traffic channels and bottom rows pertain to reverse traffic channels.

**[0033]** Again, communications are to be effectuated and maintained at the quality levels indicated by the values of the selections of the set of primary QoS level parameters 46 for each of the three communication-types 44, 152, and 154. If the determiner and selector 34 (shown in Figure 1) determines that such values cannot be effectuated or maintained, default is made to the values of the selections of the first degradation set 72, and, thereafter, to the values of the set 96, if necessary. Thereby, system overhead for service renegotiation is reduced and abrupt termination of a communication session is less likely to occur.

**[0034]** Figure 4 illustrates another service degradation



profile 32. Here, the service degradation profile is for a service subscription permitting webpage browsing. Indexed together with the IMEI 38 in the column 42 are the communication-types of audio 44, video 152, and data 154. Sets 46, 72, and 96 again form portions of the profile 32. Selections 48-54, 74-78 and 98-104 form the values of the respective sets 46, 72, and 96. And, values for forward-link and reverse-link communications are commonly-referenced with the values of the preceding Figures, again including the suffixes -A, -V, and -D, to indicate the values for audio, video, and data communications. Again, for each of the sets, top rows pertain to forward traffic channels, and bottom rows pertain to reverse traffic channels. Access is made to the service degradation profile 32 in manner analogous to those described with respect to the profiles shown in Figures 2 and 3.

**[0035]** Figure 5 illustrates another exemplary service degradation profile 32. Here, the profile is for a video-on-demand (VOD) service. Again, the profile is indexed together with an IMEI 38 associated with the mobile station pursuant to which the service subscription pertains. The column 42 again indicates communication-types of audio 44, video 152, and data 154. And, the profile 32 includes primary, first degradation, and second degradation QoS level parameters 48, 72, and 102, respectively. And, selections 48-54, 74-78, and 98-104 are associated with such sets 48, 72, and 102, respectively. Again, values of the selections are commonly-referenced with those shown in the profile shown in Figures 2-4, again with the suffixes -A, -V, and -D, for audio, video, and data communications. And, again, top rows of the sets pertain to forward traffic channels and bottom rows of the sets pertain to reverse traffic channels. Access to the profile 32 is made by the determiner and selector 34 (shown in Figure 1) in manners as described previously, thereby to reduce the need for service renegotiation and reduce the possibility that video-on-demand sessions shall be abruptly terminated.

**[0036]** Subscription can be made for communication services including more than one of the services to which the service degradation profiles shown in Figures 2-5 are representative. Subscription can analogously be made for additional communication services and service degradation profiles can analogously be created for such other communication services. And, the values of the selections of the various sets 48, 72, and 102, as well as additional sets, can conform to a generic profile or can be tailored for individual subscribers.

**[0037]** Figure 6 illustrates another exemplary service degradation profile 32. Here, analogous to the profile shown in Figure 2, the service degradation profile shown in Figure 6 the service subscription provides at least for audio communications. The service degradation profile forms part of the subscription information associated with a service subscription for subscriber service to communicate in a cellular communication system, such as the system 10 shown in Figure 1.

Again, the data forming the service degradation profile is indexed against an identifier which uniquely identifies the subscription account, here the IMEI 38. Column 42 indicates the subscription-type associated with the IMEI, here, an audio subscription 44.

**[0038]** The service degradation profile 32 shown in Figure 6 further includes a priority level 162 associated with the audio subscription type of the service subscription. The priority level, thereby, is also a permanent subscriber record which is stored in the HLR 28 (shown in Figure 1) together with other portions of the profile 32, as a default priority level for the service-type. When service subscription is made for more than one type of service, a separate priority level is associated with each service-type. For instance, service subscription can be made for audio service, web page browsing service, and video-on-demand service, all pursuant to a single service subscription. A separate priority level is associated with each of such three service-types.

**[0039]** The priority level defines a priority-of-access representing the priority to be given to the mobile station operable to the service subscription to communicate in the radio communication system pursuant to the service-type. When resources are limited and separate mobile stations contend for the limited resources, the priority level pursuant to which subscription is made for the particular service-type is used to allocate the system resources to the mobile station having the higher priority level associated therewith.

**[0040]** The priority level 162 defines a default priority for the audio service-type of the profile shown in Figure 6. The default priority can be overwritten on a per-call basis by a user during service initialization, either for a mobile-originated or a mobile-terminated call by way of L3 signaling. That is to say, a priority parameter can be entered to overwrite the default priority. A mobile-terminated call uses the default priority level, such as the level 162, together with an option for the subscriber to change the priority upon receipt of the call at the mobile station. The priority parameter used to overwrite the default priority is maintained by the system until the call is terminated.

**[0041]** Resource contention procedures are instituted, for instance, when competing subscribers simultaneously request limited resources during service initialization or when service modifications require that additional resources be allocated to a communication session. Resource contention also occurs when a handover is to be effectuated to a new cell at which new resources need to be allocated to the communication session. Also, resource contention procedures are required when a subscriber, that has been downgraded, and before service is upgraded through a previously-requested service level subsequent to renewed availability of the resources. For example, if a subscriber requests audio-only service with the highest priority, resources will be allocated to such subscriber before another subscriber is granted resources with a lower

priority. The unfulfilled service is downgraded based upon the parameters of the service degradation profile. In another exemplary implementation, QoS prioritization occurs when, even when the system is operated at full capacity, an emergency call is made. An emergency call, given a highest priority, will cause a lowest-priority call to be dropped to ensure that the emergency call is effectuated.

[0042] Remaining portions of the service degradation profile 32 shown in Figure 6 correspond to commonly-referenced portions of the profile 32 shown in Figure 2. Description of such other portions of the profile 32 is as above-described.

[0043] Figure 7 illustrates a method, shown generally at 182, of the method of an embodiment of the present invention. The method reduces a desired QoS (quality of service) level of communications between a mobile station and a fixed network of the radio communication system. The reduction is to at least a first selected degraded QoS level when continued communication pursuant to at least a first communication service at the desired QoS level is unavailable. First, and as indicated by the block 184, an indication of at least a requested QoS level is stored. Alternately, a default QoS level indicated in the SDP profile can instead be stored. The stored level is a level at which communication pursuant to the at least the first communication service are to be maintained, if possible. Then, and as indicated by the block 186, a determination is made of the resources available for a communication session. Then, and as indicated by the block 188, selection is made of a QoS level at which to effectuate or maintain a communication session. When a selection is made, the values of the service degradation profile are accessed. If the QoS level is not fulfilled, the system periodically accesses the availability of the resources, and, once the resources become available, the system grants the requested QoS level to the mobile station. Thereafter, a determination is made at the decision block 190 as to whether the requested QoS level has been fulfilled. If not, the no branch is taken back to block 186. Otherwise, if the QoS level has been fulfilled, the yes branch is taken to block 192, and the communication session is continued. A determination is then made at the decision block as to whether there has subsequently been degradation of the QoS level of communications. If not, the no branch is taken back to the block 192; otherwise the yes branch is taken back to the block 186.

[0044] Through operation of an embodiment of the present invention, system overhead required for service renegotiation when parameters of a desired QoS level cannot be attained or maintained is reduced. Also, because service degradation is effectuated pursuant to a service degradation profile, abrupt termination of a communication session is less likely to occur if the parameters of the desired QoS level cannot be assured.

[0045] The previous descriptions are of preferred examples for implementing the invention, and the scope

of the invention should not necessarily be limited by this description. The scope of the present invention is defined by the following claims.

## Claims

1. In a radio communication system having a fixed network including a plurality of spaced-apart, fixed-site transceivers positioned throughout a geographic area, each fixed-site transceiver defining a coverage area in which communications with a mobile station are permitted pursuant to a service subscription, a combination with the fixed network of apparatus for reducing a desired QoS (quality of service) level of communications between the mobile station and the fixed network to a selected degraded QoS level when continued communications pursuant to at least a first communication service at the desired QoS level is unavailable, said apparatus comprising:

a service subscription register associated with the mobile station, said service subscription register for storing an indication of at least a first selected degraded QoS level at which the communications pursuant to the at least the first communication service are to be maintained if the continued communications at the desired QoS level are unable to be maintained; and  
a resource availability determiner and service level selector coupled to receive information representative of the at least the first selected degraded QoS level when the communications are unavailable at the desired QoS level, said resource reserver for selectively reserving resources of the radio communication system to assure that the communications are able to continue pursuant to the at least the first degraded QoS level.

2. The apparatus of claim 1 wherein the at least the first selected degraded QoS level stored at said service subscription register comprises the first selected degraded QoS level and at least a second selected degraded QoS level, the second selected degraded QoS level at which the communications pursuant to the at least the first communication service are to be maintained if the continued communications at the desired QoS level and the first selected degraded QoS level are unable to be maintained.
3. The apparatus of claim 2 wherein said resource availability determiner and service level selector selectively reserves resources of the radio communication system to assure that the communications are able to continue pursuant to the at least the sec-



ond degraded QoS level when the continued communications are unable to be maintained at the first selected degraded QoS level.

4. The apparatus of any of claims 1 to 3 wherein the at least the first selected degraded QoS level comprises a first selected forward-link degraded QoS level and a first selected reverse-link degraded QoS level. 5
5. The apparatus of any of claims 1 to 4 wherein the at least the first communication service comprises the first communication service and at least a second communication service and wherein the first selected degraded QoS level of which the indication thereof is stored by said service subscription register comprises a first selected first-communication-service degraded QoS level at which the communications pursuant to the first communication service are to be maintained and a first selected second-communication-service degraded QoS level at which the communications pursuant to the second communication service are to be maintained. 10
6. The apparatus of any of claims 1 to 5 wherein the at least the first communication service comprises a video conference service and wherein the first selected degraded QoS level of which the indication thereof is stored at said service subscription register comprises a first selected video-conference-service degraded QoS level. 15
7. The apparatus of claim 6 wherein the first selected video-conference-service degraded QoS level comprises a first selected degraded data QoS level. 20
8. The apparatus of claim 6 wherein the first selected video-conference-service degraded QoS level comprises a first selected degraded video QoS level. 25
9. The apparatus of claim 6 wherein the first selected video-conference-service degraded QoS level comprises a first selected degraded audio QoS level. 30
10. The apparatus of any of claims 1 to 5 wherein the at least the first communication service comprises a web browsing service and wherein the first selected degraded QoS level of which the indication thereof is stored at said service subscription register comprises a first selected web-browser service degraded QoS level. 35
11. The apparatus of claim 10 wherein the first selected web-browser-service degraded QoS level comprises a first selected degraded data QoS level. 40
12. The apparatus of claim 10 wherein the first selected web-browser-service degraded QoS level com- 45

prises a first selected degraded audio QoS level.

13. The apparatus of claim 10 wherein the first selected web-browser-service degraded QoS level comprises a first selected degraded video QoS level. 50
14. The apparatus of any of claims 1 to 5 wherein the at least the first communication service comprises a video on demand service and wherein the first selected degraded QoS level of which the indication thereof is stored at said service subscription register comprises a first selected video-on-demand service degraded QoS level. 55
15. The apparatus of any of claims 1 to 14 wherein said service subscription register further stores a priority level associated with the at least the first communication service, each priority level identifying a priority-of-access representing priority to be given to the mobile station to communication in the radio communication system pursuant to the at least the first communication service.
16. The apparatus of claim 15 wherein the priority level stored at said service subscription register comprises a default priority level, a substitute priority level selectable at least during service initiation by the mobile station.
17. The apparatus of claim 1 wherein the radio communication system includes a first mobile station with which communications are permitted pursuant to a first service subscription and at least a second mobile station with which communications are permitted pursuant to at least a second service subscription, wherein a first service subscription register is associated with the first mobile station and a second service subscription register is associated with the second mobile station, said first service subscription for storing an indication of the first degraded QoS level at which communications with the first mobile station pursuant to the first communication service are to be maintained and a first priority level associated therewith, and said second service subscription register for storing an indication of the first degraded QoS level at which communications with the second mobile station pursuant to the first communication service are to be maintained and a second priority level associated therewith.
18. The apparatus of claim 17 wherein said resource availability determiner and service level selector further compares the first priority level and the second priority level when the first mobile station and the second mobile station contend for common resources, results of comparisons by said resource availability determiner and service level selector

determinative of which of the first mobile station and the second mobile station is given priority of access to the common resources.

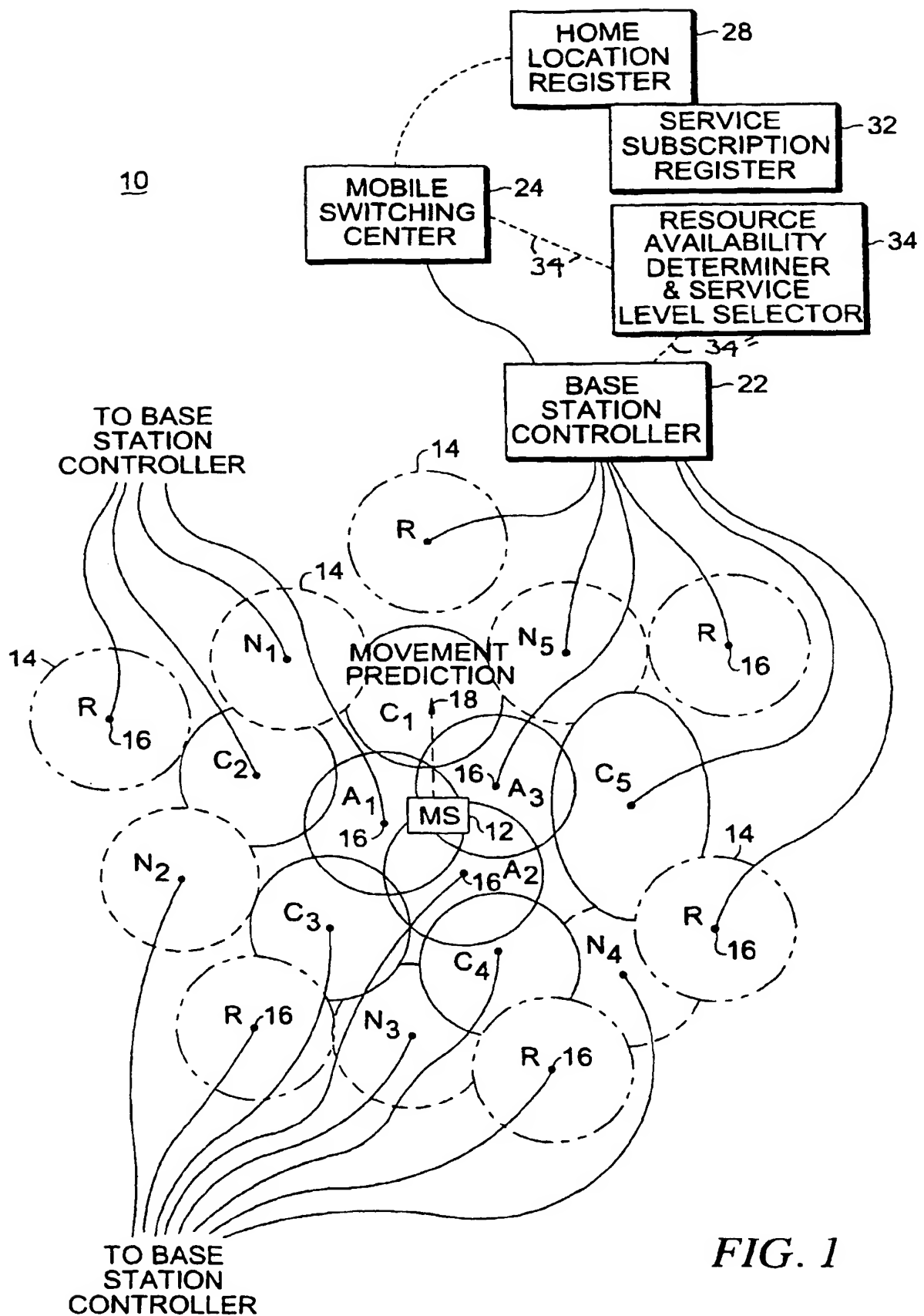
19. A method for reducing a desired QoS (quality of service) level of communications between a mobile station and a fixed network of a radio communication system to a selected degraded QoS level when communication pursuant to at least a first communication service at the desired QoS level is unavailable, said method comprising the steps of:

storing an indication of at least a first selected degraded QoS level at which the communications pursuant to the at least the first communication service are to be maintained if the communications at the desired QoS level are unable to be maintained;  
determining availability of resources for the communication pursuant to the first communication service at the desired QoS level; and  
selecting the communication at the first selected degraded QoS level if a determination is made during said step of determining that the communication at the desired QoS level is unavailable.

20. In a cellular communication system having a network infrastructure installed in a geographic region and mobile stations capable of communication with the network infrastructure pursuant to at least a first communication, when located in the geographic region, a combination with the network infrastructure of a storage device for storing SDP (service degradation performance) data, said storage device comprising:

a mobile station identifier portion for storing mobile station identification indicia which uniquely identifies various ones of the mobile stations;  
a SDP data storage portion having locations indexed together with the mobile station identification indicia stored at said mobile station identifier portion, each location of said SDP data storage portion for storing an indication of at least a first degraded QoS level at which communications are to be maintained between the network infrastructure and the mobile station to which the location of said SDP data storage portion is indexed together if the communications are unable at a desired QoS level.

55



*FIG. 1*

IMEI	TYPE	PRIMARY/SELECTION		1ST/DEGRADATION/SELECTION		2ND/DEGRADATION/SELECTION	
		BIT RATE	DELAY TIME	BIT RATE	DELAY TIME	BIT RATE	DELAY TIME
		56	58	82	84	106	108
		64	66	88	92	114	116
						86	94

FIG 2

FIG. 2

IMEI	TYPE	PRIMARY/SELECTION		1ST DEGRADATION		2ND DEGRADATION	
		BIT RATE	DELAY TIME	BIT RATE	DELAY TIME	BIT RATE	DELAY TIME
		56-A 14.4	A	82-A 14.4	A1	106-A 14.4	A2
		64-A 14.4	C	88-A 14.4	C1	114-A 14.4	C2
VIDEO	152	56-V 384	E	82-V 144	E1	106-V 0	E2
		64-V 384	G	88-V 144	G1	114-V 0	G2
DATA	154	56-D 144	I	82-D 64	I1	106-D 64	I2
		64-D 144	K	88-D 64	K1	114-D 64	K2

FIG. 3

TYPE 42	PRIMARY SELECTION				1ST DEGRADATION				WEB PAGE BROWSING			
	BIT RATE		DELAY TIME		BIT RATE		DELAY TIME		BIT RATE		DELAY TIME	
	56-A	14.4	58-A	A	B	82-A	0	84-A	A1	B1	0	A2
AUDIO 44	64-A	0	C	62-A	D	0	0	C1	86-A	D1	0	C2
	56-V	128	E		F	0	0	E1		F1	0	E2
VIDEO 152	64-V	0	G		H	0	0	G1		H1	0	G2
	56-D	128	I		J	28.8	11	I1		J1	BE	I2
DATA 154	64-D	9.6	K		L	9.6	K1	K1		L1	9.6	K2

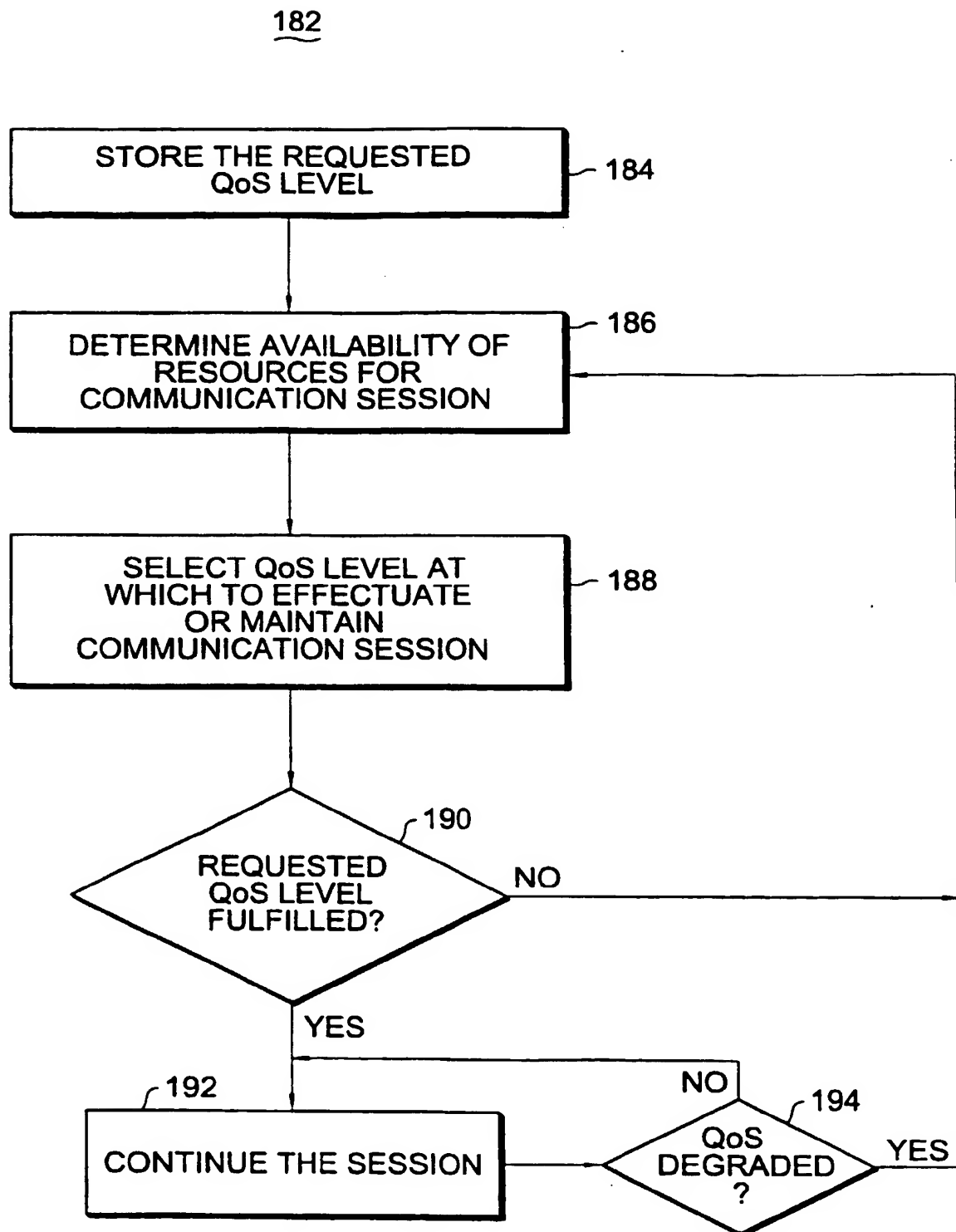
FIG. 4

TYPE 42	PRIMARY SELECTION				1ST DEGRADATION				2ND DEGRADATION			
	BIT RATE		DELAY TIME		BIT RATE		DELAY TIME		BIT RATE		DELAY TIME	
	56	14.4	A		B	14.4	A1		B1	9.6	A2	
AUDIO 44	64	0	C		D	0	C1		D1	0	C2	
	56-V	2048	E		F	384	E1		F1	144	E2	
VIDEO 152	64-V	0	G		H	0	G1		H1	0	G2	
	56-D	9.6	I		J	9.6	I1		J1	9.6	I2	
DATA 154	64-D	9.6	K		L	9.6	K1		L1	9.6	K2	

FIG. 5

42		48	32		46		54		72		78		96		104	
			52		74		82		88		94		100		106	
TIME		TYPE	PRIMARY/SELECTION		1ST/DEGRADATION/SELECTION		2ND/DEGRADATION/SELECTION									
			BIT RATE	DELAY TIME	BER	BIT RATE	DELAY TIME	BER	BIT RATE	DELAY TIME	BER					
IMEI		AUDIO	56		58		62		82		84		86		106	
			64		66		68		88		92		94		114	
38		44	162		1											



*FIG. 7*

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